WHAT IS CLAIMED IS:

1. A method of correctly identifying areas near character edges in character image data, comprising:

5 performing a combination of predetermined tests on a portion of the character image data representing a character and a background in sets of pixel color component values, the predetermined tests each determining whether or not the portion is a white area and generating a set of test results;

assigning a white level value to the portion based upon the test results of the

10 predetermined tests; and

comparing the portion to a set of predetermined white patterns if the white level value and the test results satisfy one of predetermined conditions.

2. The method of identifying character edge areas in character image data

15 according to claim 1 further comprising:

performing an edge-enhancement process on the character image data so as to generate edge-enhanced character image data before said performing the set of said predetermined tests; and

converting each of the pixel values in the portion to white if the portion contains

20 one of the predetermined white patterns to generate a white converted portion after said comparing the portion to the set of predetermined white patterns.

3. The method of identifying character edge areas in character image data according to claim 1 wherein a first one of the predetermined tests determines whether or

25 not every one of the pixel color component values is below a first predetermined threshold value.

4. The method of identifying character edge areas in character image data according to claim 3 wherein a second one of the predetermined tests includes a

30 comparison that any B image data of RGB image data in a predetermined size matrix with a centrally located current pixel is under a predetermined threshold.

5. The method of identifying character edge areas in character image data according to claim 4 wherein a third one of the predetermined tests includes a first component that determines a first minimal value (miny) among a set of the pixel color component values of first pixels and a first maximal value (maxy) among a set of the pixel color component values of second pixels including a centrally located pixel, a second component determining a second minimal value (mint) among a set of the pixel color component values of third pixels and a second maximal value (maxt) among a set of the pixel color component values of fourth pixels including the centrally located pixel, a third component determining ((miny-maxy) > 0) OR ((mint-maxt) > 0).

6. The method of identifying character edge areas in character image data according to claim 5 wherein said white level value is assigned a predetermined highest value when the test results of said first one of the predetermined tests are affirmative.

7. The method of identifying character edge areas in character image data according to claim 6 wherein the test results of said second one of the predetermined tests are examined if the test results of said first one of the predetermined tests are negative.

8. The method of identifying character edge areas in character image data according to claim 7 wherein said white level value is decremented by a predetermined value when the test results of said second one of the predetermined tests are negative.

9. The method of identifying character edge areas in character image data according to claim 7 wherein the pixel color component values are binarized when the test results of said second one of the predetermined tests are affirmative, a predetermined first white value threshold, a predetermined second white value threshold as well as a predetermined value being adjustably defined.

10. The method of identifying character edge areas in character image data according to claim 9 wherein if the binarized pixel component values are determined as a white area and said white level value is equal to or above the predetermined first white value threshold, said white level value is incremented by the predetermined value.

11. The method of identifying character edge areas in character image data according to claim 9 wherein if the binarized pixel component values are determined as a non-white area, said white level value is decremented by the predetermined value.

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12. The method of identifying character edge areas in character image data according to claim 9 wherein the test results of said third one of the predetermined tests are examined if the binarized pixel component values are determined as a white area, said white level value is not equal to or above the predetermined first white value threshold and, 10   said white level value is equal to or above a predetermined second white value threshold.

13. The method of identifying character edge areas in character image data according to claim 12 wherein if the test results of said third one of the predetermined tests are negative, said white level value is decremented by the predetermined value.

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14. The method of identifying character edge areas in character image data according to claim 9 wherein if the binarized pixel component values are determined as a white area and said white level value is not equal to or above the predetermined first white value threshold and the predetermined second white value threshold, said white level value 20   is decremented by the predetermined value.

15. The method of identifying character edge areas in character image data according to claim 2 further comprising detecting edges in the portion of the character image data to generate an edge signal.

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16. The method of identifying character edge areas in character image data according to claim 15 further comprising performing a first dot pattern peak test based upon a first certain set of color component pixel values of the portion to determine a first dot pattern peak, a first component of said first dot pattern peak test determining whether 30   or not a color component pixel value of a centrally located pixel of the portion has the highest value or the lowest value in the portion; a second component of said first dot pattern peak test determining whether or not an absolute difference in the color component

pixel value of the centrally located pixel and an average of each pair of the color component pixel values of pixels that are symmetrically located about the centrally located pixel exceeds a predetermined dot pattern peak threshold value.

5   17. The method of identifying character edge areas in character image data according to claim 16 further comprising performing a second dot pattern peak test based upon a second certain set of color component pixel values of the portion to determine a second dot pattern peak, a first component of said second dot pattern peak test determining whether or not a color component pixel value of a centrally located pixel of the portion has the highest value or the lowest value in the portion; a second component of said second dot pattern peak test determining whether or not an absolute difference in the color component pixel value of the centrally located pixel and an average of each pair of the color component pixel values of pixels that are symmetrically located about the centrally located pixel exceeds the predetermined dot pattern peak threshold value.

          18. The method of identifying character edge areas in character image data according to claim 17 further comprising generating the dot pattern peak signal if a total number of the first dot pattern peaks and the second dot pattern peaks in the portion exceeds a predetermined total dot pattern threshold value.

          19. The method of identifying character edge areas in character image data according to claim 18 further comprising determining whether or not the portion is a part of a character based upon the white converted portion, the edge signal and the dot pattern peak signal.

          20. The method of identifying character edge areas in character image data according to claim 17 further comprising determining a color component continuous pixel number of each of color components in the portion based upon a predetermined set of continuous pixel patterns.

          21. The method of identifying character edge areas in character image data according to claim 20 further comprising determining whether or not the portion is a part

of an inner space of a character based upon the white converted portion, the dot pattern peak signal and the color component continuous pixel number.

22.   The method of identifying character edge areas in character image data according to claim 3 wherein a second one of the predetermined tests includes a first component that generates a=1 if a difference between a maximal one and a minimal one of the pixel color component values of a predetermined centrally located pixel is above a second predetermined threshold value, a second component generating b=1 if any one of the pixel color component values of a predetermined pattern of first pixels near the centrally located pixel is below a third threshold value, a third component generating c=1 if any one of the pixel color component values of the predetermined pattern of second pixels that is symmetrical to the first pixels about the centrally located pixel is below the third threshold value, a fourth component determining a AND (b EXNOR c).

23.   The method of identifying character edge areas in character image data according to claim 22 wherein a third one of the predetermined tests includes a first component that determines a first minimal value (miny) among a set of the pixel color component values of first pixels and a first maximal value (maxy) among a set of the pixel color component values of second pixels including a centrally located pixel, a second component determining a second minimal value (mint) among a set of the pixel color component values of third pixels and a second maximal value (maxt) among a set of the pixel color component values of fourth pixels including the centrally located pixel, a third component determining ((miny-maxy) > 0) OR ((mint-maxt) > 0).

24.   The method of identifying character edge areas in character image data according to claim 23 wherein said white level value is assigned a predetermined highest value when the test results of said first one of the predetermined tests are affirmative.

25.   The method of identifying character edge areas in character image data according to claim 24 wherein the test results of said second one of the predetermined tests are examined if the test results of said first one of the predetermined tests are negative.

26. The method of identifying character edge areas in character image data according to claim 25 wherein said white level value is decremented by a predetermined value when the test results of said second one of the predetermined tests are affirmative.

5   27. The method of identifying character edge areas in character image data according to claim 25 wherein the pixel color component values are binarized when the test results of said second one of the predetermined tests are negative, a predetermined first white value threshold, a predetermined second white value threshold as well as a predetermined value being adjustably defined.

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28. The method of identifying character edge areas in character image data according to claim 27 wherein if the binarized pixel component values are determined as a white area and said white level value is equal to or above the predetermined first white value threshold, said white level value is incremented by the predetermined value.

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29. The method of identifying character edge areas in character image data according to claim 27 wherein if the binarized pixel component values are determined as a non-white area, said white level value is decremented by the predetermined value.

20   30. The method of identifying character edge areas in character image data according to claim 27 wherein the test results of said third one of the predetermined tests are examined if the binarized pixel component values are determined as a white area and said white level value is not equal to or above the predetermined first white value threshold, and said white level value is equal to or above the predetermined second white 25   value threshold.

31. The method of identifying character edge areas in character image data according to claim 30 wherein if the test results of said third one of the predetermined tests are negative, said white level value is decremented by the predetermined value.

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32. The method of identifying character edge areas in character image data according to claim 27 wherein if the binarized pixel component values are determined as a

white area and said white level value is not equal to or above the predetermined first white value threshold and the predetermined second white value threshold, said white level value is decremented by the predetermined value.

5   33. A system for correctly identifying areas near character edges in character image data, comprising:

an input unit for inputting character image data representing a character and a background in sets of pixel color component values;

a white extraction unit connected to said input unit for performing a combination

10   of predetermined tests on a portion of the character image data, the predetermined tests each determining whether or not the portion is a white area and generating a set of test results; and

a white determination unit connected to said white extraction unit for assigning a white level value to the portion based upon the test results of the predetermined tests; and

15   a white pattern matching unit connected to said white determination unit for comparing the portion to a set of predetermined white patterns if the white level value and the test results satisfy one of predetermined conditions.

34. The system for identifying character edge areas in character image data

20   according to claim 33 further comprising:

an edge enhancement unit connected between said input unit and said white extraction unit for performing an edge-enhancement process on the character image data so as to generate edge-enhanced character image data; and

a white correction unit connected to said white pattern matching unit for

25   converting each of the pixel values in the portion to white if the portion contains one of the predetermined white patterns to generate a white converted portion.

35. The system for identifying character edge areas in character image data according to claim 33 wherein said white determination unit performs a first one of the

30   predetermined tests to determine whether or not every one of the pixel color component values is below a first predetermined threshold value.

36.   The system for identifying character edge areas in character image data according to claim 35 wherein said white determination unit performs a second one of the predetermined tests to detects if any B image data of RGB image data in a predetermined size matrix with a centrally located current pixel is under a predetermined threshold.

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37.   The system for identifying character edge areas in character image data according to claim 36 wherein said white determination unit performs a third one of the predetermined tests, the third one of the predetermined tests including a first component that determines a first minimal value (miny) among a set of the pixel color component

10   values of first pixels and a first maximal value (maxy) among a set of the pixel color component values of second pixels including a centrally located pixel, a second component determining a second minimal value (mint) among a set of the pixel color component values of third pixels and a second maximal value (maxt) among a set of the pixel color component values of fourth pixels including the centrally located pixel, a third component

15   determining ((miny-maxy) > 0) OR ((mint-maxt) > 0).

38.   The system for identifying character edge areas in character image data according to claim 37 wherein said white determination unit assigns said white level value a predetermined highest value when the test results of said first one of the predetermined

20   tests are affirmative.

39.   The system for identifying character edge areas in character image data according to claim 37 wherein said white extraction unit examines the test results of said second one of the predetermined tests when the test results of said first one of the

25   predetermined tests are negative.

40.   The system for identifying character edge areas in character image data according to claim 38 wherein said white determination unit decrements said white level value by a predetermined value when the test results of said second one of the

30   predetermined tests are negative.

41. The system for identifying character edge areas in character image data according to claim 39 wherein said white determination unit binarizes the pixel color component values when the test results of said second one of the predetermined tests are affirmative, a predetermined first white value threshold, a predetermined second white value threshold as well as a predetermined value being adjustably defined.

42. The system for identifying character edge areas in character image data according to claim 41 wherein if said white determination unit determines the binarized pixel component values as a white area and that said white level value is equal to or above the predetermined first white value threshold, said white determination unit increments said white level value by the predetermined value.

43. The system for identifying character edge areas in character image data according to claim 41 wherein if said white determination unit determines the binarized pixel component values as a non-white area, said white determination unit decrements said white level by the predetermined value.

44. The system for identifying character edge areas in character image data according to claim 41 wherein said white determination unit examines the test results of said third one of the predetermined tests if the binarized pixel component values are determined as a white area, said white level value is not equal to or above the predetermined first white value threshold and said white level value is equal to or above a predetermined second white value threshold.

45. The system for identifying character edge areas in character image data according to claim 44 wherein if the test results of said third one of the predetermined tests are negative, said white determination unit decrements said white level value by the predetermined value.

46. The system for identifying character edge areas in character image data according to claim 41 wherein if said white determination unit determines the binarized pixel component values as a white area and said white level value is not equal to or above

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the predetermined first white value threshold and the predetermined second white value threshold, said white determination unit decrements said white level value by the predetermined value.

5   47.   The system for identifying character edge areas in character image data according to claim 33 further comprising an edge detection unit connected to said input unit for detecting edges in the portion of the character image data to generate an edge signal.

10   48.   The system for identifying character edge areas in character image data according to claim 47 further comprising a dot pattern extraction unit connected to said input unit for performing a first dot pattern peak test based upon a first certain set of color component pixel values of the portion to determine a first dot pattern peak, a first component of said first dot pattern peak test determining whether or not a color component

15   pixel value of a centrally located pixel of the portion has the highest value or the lowest value in the portion; a second component of said first dot pattern peak test determining whether or not an absolute difference in the color component pixel value of the centrally located pixel and an average of each pair of the color component pixel values of pixels that are symmetrically located about the centrally located pixel exceeds a predetermined dot

20   pattern peak threshold value.

         49.   The system for identifying character edge areas in character image data according to claim 48 wherein said dot pattern extraction unit performs a second dot pattern peak test based upon a second certain set of color component pixel values of the

25   portion to determine a second dot pattern peak, a first component of said second dot pattern peak test determining whether or not a color component pixel value of a centrally located pixel of the portion has the highest value or the lowest value in the portion; a second component of said second dot pattern peak test determining whether or not an absolute difference in the color component pixel value of the centrally located pixel and an average

30   of each pair of the color component pixel values of pixels that are symmetrically located about the centrally located pixel exceeds the predetermined dot pattern peak threshold value.

50. The system for identifying character edge areas in character image data according to claim 49 wherein said dot pattern extraction unit further generating the dot pattern peak signal if a total number of the first dot pattern peaks and the second dot

5   pattern peaks in the portion exceeds a predetermined total dot pattern threshold value.

51. The system for identifying character edge areas in character image data according to claim 50 further comprising a character final determination unit connected to said white correction unit and said dot pattern extraction unit for determining whether or

10   not the portion is a part of a character based upon the white converted portion, the edge signal and the dot pattern peak signal.

52. The system for identifying character edge areas in character image data according to claim 49 further comprising a color determination unit connected to said input

15   unit for determining a color component continuous pixel number of each of color components in the portion based upon a predetermined set of continuous pixel patterns.

53. The system for identifying character edge areas in character image data according to claim 52 further comprising a character inner space final determination unit

20   connected to said color determination unit, said white correction unit and said dot pattern extraction unit for determining whether or not the portion is a part of an inner space of a character based upon the white converted portion, the dot pattern peak signal and the color component continuous pixel number.

25   54.   The system for identifying character edge areas in character image data according to claim 24 wherein said white determination unit performs a second one of the predetermined tests, the second one of the predetermined tests including a first component that generates a=1 if a difference between a maximal one and a minimal one of the pixel color component values of a predetermined centrally located pixel is above a second

30   predetermined threshold value, a second component generating b=1 if any one of the pixel color component values of a predetermined pattern of first pixels near the centrally located pixel is below a third threshold value, a third component generating c=1 if any one of the

pixel color component values of the predetermined pattern of second pixels that is symmetrical to the first pixels about the centrally located pixel is below the third threshold value, a fourth component determining a AND (b EXNOR c).

5   55. The system for identifying character edge areas in character image data according to claim 54 wherein said white determination unit performs a third one of the predetermined tests, the third one of the predetermined tests including a first component that determines a first minimal value (miny) among a set of the pixel color component values of first pixels and a first maximal value (maxy) among a set of the pixel color

10   component values of second pixels including a centrally located pixel, a second component determining a second minimal value (mint) among a set of the pixel color component values of third pixels and a second maximal value (maxt) among a set of the pixel color component values of fourth pixels including the centrally located pixel, a third component determining ((miny-maxy) > 0) OR ((mint-maxt) > 0).

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          56. The system for identifying character edge areas in character image data according to claim 55 wherein said white determination unit assigns said white level value a predetermined highest value when the test results of said first one of the predetermined tests are affirmative.

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          57. The system for identifying character edge areas in character image data according to claim 55 wherein said white extraction unit examines the test results of said second one of the predetermined tests when the test results of said first one of the predetermined tests are negative.

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          58. The system for identifying character edge areas in character image data according to claim 57 wherein said white determination unit decrements said white level value by a predetermined value when the test results of said second one of the predetermined tests are affirmative.

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          60. The system for identifying character edge areas in character image data according to claim 57 wherein said white determination unit binarizes the pixel color

component values when the test results of said second one of the predetermined tests are negative, a predetermined first white value threshold, a predetermined second white value threshold as well as a predetermined value being adjustably defined.

5   61. The system for identifying character edge areas in character image data according to claim 60 wherein if said white determination unit determines the binarized pixel component values as a white area and said white level value is equal to or above the predetermined first white value threshold, said white determination unit increments said white level value by the predetermined value.

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62. The system for identifying character edge areas in character image data according to claim 60 wherein if said white determination unit determines the binarized pixel component values as a non-white area, said white determination unit decrements said white level by the predetermined value.

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63. The system for identifying character edge areas in character image data according to claim 60 wherein said white determination unit examines the test results of said third one of the predetermined tests if the binarized pixel component values are determined as a white area, said white level value is not equal to or above the

20   predetermined first white value threshold and said white level value is equal to or above the predetermined second white value threshold.

64. The system for identifying character edge areas in character image data according to claim 63 wherein if the test results of said third one of the predetermined tests

25   is negative, said white determination unit decrements said white level value by the predetermined value.

65. The system for identifying character edge areas in character image data according to claim 60 wherein if said white determination unit determines the binarized

30   pixel component values as a white area and said white level value is not equal to or above the predetermined first white value threshold and the predetermined second white value

threshold, said white determination unit decrements said white level value by the predetermined value.